Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

SHOUT
SHARE
IT

A99
.9
F7632U
Cop 3

586
80

U. S. Forest Service Research Paper RM-14 August 1965

ROTATION, REST-ROTATION, AND SEASON-LONG GRAZING ON A MOUNTAIN RANGE IN WYOMING[1]

by

W. M. Johnson, Principal Plant Ecologist

Rocky Mountain Forest and Range Experiment Station[2]

U. S. DEPARTMENT OF AGRICULTURE

[1]Comparisons reported were undertaken jointly with the Medicine Bow National Forest.

[2]Central headquarters maintained in cooperation with Colorado State University at Fort Collins; author is located at Laramie in cooperation with the University of Wyoming.

586

CONTENTS

	Page
Description of the area	2
Results	5
Utilization on allotments	5
Utilization by species and units	7
Utilization by period of use	9
Changes in plant cover	9
Discussion	10
Common and botanical names of species mentioned	15

Rotation, Rest-Rotation, and Season-Long Grazing on a Mountain Range in Wyoming

by

W. M. Johnson

One of the most important problems facing managers of cattle ranges in the western United States is how to obtain better distribution of grazing. On almost all cattle ranges there are certain areas where grazing is concentrated, while adjacent areas may be very lightly grazed. This is especially noticeable where the range is composed of moist bottom lands interspersed with drier uplands. Areas of concentrated grazing may also develop away from water. On these areas the preferred forage plants are heavily utilized, and less desirable plants are grazed very lightly, if at all. For this reason, it is sometimes difficult to improve range conditions even when numbers of livestock are in balance with forage production.

The Pole Mountain unit of the Medicine Bow National Forest in Wyoming is an example of a cattle range where these problems exist (fig. 1). Three allotments in this unit were selected for study: the North Pasture, Green Mountain, and Lodgepole. Previously, under season-long grazing (June 1 to October 15), cattle on the North Pasture Allotment grazed only about one-half of the usable range area. Some of this area, principally in the southwest quarter of the allotment, was grazed in excess of 50 percent utilization. The remainder was grazed very lightly, principally along the bottoms.

Green Mountain was an example of heavy grazing throughout the entire allotment, with the bottom areas grazed excessively. Topography, water distribution, and forage types were similar to the North Pasture Allotment. Except for scattered rock outcrops and occasional patches of dense timber, all portions of the allotments were easily accessible to livestock.

The bottom areas in the Lodgepole Allotment were all very heavily grazed, but some of the upland areas were grazed more moderately. Topography and forage types in the northeast quarter of this allotment were similar to the other two allotments, therefore observations were confined to this area.

The object of this study was to evaluate three methods of management in relation to their effect on patterns of utilization on upland and bottom areas, and accompanying changes in the vegetation.

Different methods of management were compared on the three allotments. The North Pasture Allotment was divided into four units about equal in grazing capacity for rest-rotation management. Three units were grazed each season, while the fourth was left ungrazed for that season. The period of use on each unit and the unit not grazed for each of the 4 years of the study were as follows:

	Year and Unit No.			
	1958	1959	1960	1961
June 1-July 16	1	2	3	4
July 17-Aug. 31	2	3	4	1
Sept. 1-Oct. 15	3	4	1	2
Not grazed	4	1	2	3

The Green Mountain Allotment was also divided into four units, but all units were grazed each year in a simple four-pasture rotation system. The time of grazing was rotated as follows:

	Year and Unit No.			
	1958	1959	1960	1961
June 1-July 4	2	3	4	1
July 5-Aug. 7	3	4	1	2
Aug. 8-Sept. 10	4	1	2	3
Sept. 11-Oct. 15	1	2	3	4

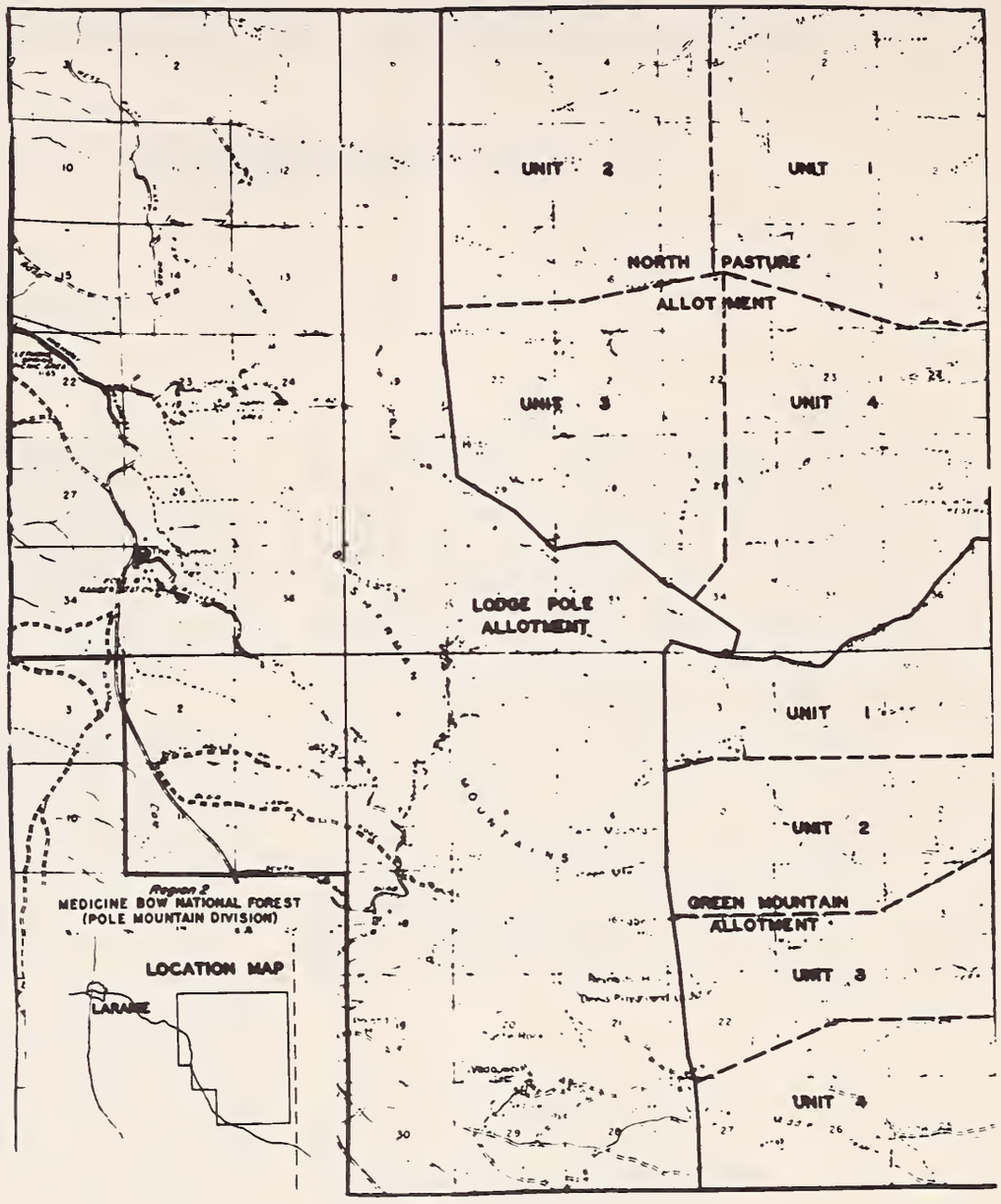


Figure 1.--Location of Pole Mountain Allotments used in this study.

The Lodgepole Allotment was continued under season-long management, and used as a check to help evaluate changes in utilization and vegetation on the other two allotments.

During the period of study, no changes were made in the numbers of livestock permitted to graze the allotments. Some fluctuations occurred on the Lodgepole Allotment, however, because some permittees kept their livestock on their home ranges until after the breeding season. This amounted to reductions in use of approximately 900 animal months in 1959 and 450 animal months in 1960. Permitted use on this allotment was 3,213 animal months.

Description of the Area

The North Pasture Allotment contained 16,603 acres, of which 15,548 acres were usable range. Actual grazing use from 1950 to 1958 had been 1,949 animal months per year.

On this area, only three vegetation types contributed importantly to acreage and grazing capacity. The largest (8,738 acres, fig. 2) was the grassland type, where Griffiths wheatgrass,[3] slimstem muhly, and three-tip sage-

[3] *Common and botanical names of species are listed on page 15.*

Figure 2.--Grassland types occur on upland areas of gently rolling topography. Stream channels are seldom incised more than 50 to 75 feet.

brush were dominants, and prairie Junegrass, Idaho fescue, Sandberg bluegrass, and Parry danthonia were associated species.

The mixed shrub type dominated by big sagebrush, bitterbrush, and Griffiths wheatgrass occupied 2,714 acres. The same type but with an open stand of ponderosa pine occupied 2,409 acres. For evaluation purposes these two types were considered the same. Associated species were Idaho fescue, spike-fescue, western wheatgrass, needle-and-thread, and sun sedge (fig. 3).

The most important species in the meadow type along the valley bottoms were various sedges and rushes, Kentucky bluegrass, tufted hairgrass, and bluejoint reedgrass. This type occupied 122 acres (fig. 4).

Observations on the North Pasture Allotment were confined to these three major vegetation types.

The Green Mountain Allotment contained 9,351 acres, of which 8,974 were usable range. Actual grazing use had been 2,250 animal months per year.

The same forage types were present as on the North Pasture Allotment, but only two of these were important from an area and graz-

Figure 3.--The mixed shrub types occur on slightly steeper slopes than the grasslands, and are well vegetated.

Figure 4.--Meadows vary from semi-dry and well drained to very wet and boggy areas. The boggy areas were not studied.

ing capacity standpoint--the open grasslands and the meadow types. The species composition was very similar to that on the North Pasture Allotment, but some of the more desirable grasses (Parry danthonia, spikefescue, mountain muhly, and others) were less abundant and plant vigor was much lower.

The Lodgepole Allotment joins the Green Mountain Allotment on the west and the North Pasture Allotment on the south. Only a small portion of the allotment (the northeast corner) was evaluated. The area was approximately the same size as one unit of the Green Mountain Allotment, and contained approximately the same proportion and distribution of vegetative types.

For the Green Mountain and Lodgepole Allotments, the evaluation was confined to the grassland and meadow types of vegetation.

Six locations in grassland, six in sagebrush, and six in meadow types in each of the four units in the North Pasture Allotment were studied. To better evaluate changes in plant cover, the six locations in the meadows were further categorized as "wet" and "dry" meadows. Three locations in the grassland and three in bottom types in each unit of the Green Mountain Allotment and in the study area of the Lodgepole Allotment were studied. All locations were selected to be as nearly typical of existing conditions as possible.

At each location, one cluster of two transects was established to measure changes in the vegetative cover. The 3-step method developed by Parker [4] was followed. The transects were permanently located and measured in 1958, and remeasured in 1962 and 1963. Measurements made in 1958 were considered pretreatment data. Effectiveness of the proposed management procedure was measured in terms of change from 1958 conditions.

The degree of herbage utilization was based on the percent of weight removed in relation to percent of height removed. [5] These measurements were obtained each year at the end of the grazing period on each unit.

Species selected for utilization measurement on the grassland and browse types were Griffiths wheatgrass, slimstem muhly, needle-and-thread, Idaho fescue, and sun sedge. The first two species are not considered choice forage species, but were used because the more desirable species such as mountain muhly, Idaho fescue, needle-and-thread, and

[4] *Parker, Kenneth W. A method for measuring trend in range condition on national forest ranges. 26 pp., illus. 1951. (Unpublished report on file at U. S. Forest Serv., Washington, D. C.)*

[5] *Lommasson, T. and Jensen, Chandler. Determining utilization of range grasses from height-weight table. Jour. Forestry 41: 589-593, illus. 1943.*

Parry danthonia were not always present in sufficient abundance to measure.

On the meadows the species selected for utilization measurements were slender wheatgrass, Kentucky bluegrass, tufted hairgrass, needle-and-thread, Nebraska sedge, needleleaf sedge, and shortbeak sedge. These were considered choice forage species.

Results

Utilization on Allotments

How the system of management influences utilization was studied by comparing the use of the types during the 1956-57 period ("pretreatment"), when all allotments were grazed season-long, with the utilization during the 1958-61 period ("treatment"), when the Lodgepole Allotment was grazed season-long, and the North Pasture and Green Mountain Allotments were grazed under rotation plans. By allotments and vegetative types, the average utilization of all species, measured by percent of weight removed was as follows:

	Pretreatment 1956-57	Treatment 1958-61
Lodgepole (season-long grazing, both periods):		
Grassland	10.0	9.0
Meadow	31.6	33.0
Green Mountain (rotation grazing):		
Grassland	13.1	9.6
Meadow	41.1	16.1
North Pasture (rest-rotation grazing):		
Grassland	8.0	4.2
Meadow	28.0	17.8
Mixed browse	13.2	6.4

There was no significant change in utilization on the Lodgepole Allotment, which was grazed season-long during both the pretreatment and treatment periods.

Rotation management on the Green Mountain Allotment during 1958-61 reduced average utilization on grassland types slightly below the pretreatment level, but the reduction probably was not of practical significance. On the meadows, however, utilization during the rotation period was reduced from 41 to 16 percent. This reduction was clearly evident on all meadow areas (fig. 5). Their condition was a striking contrast to the condition of the same meadows during the pretreatment period, or to similar meadows in the Lodgepole Allotment (fig. 6).

Figure 5.--At end of the season, Unit 1 of the Green Mountain Allotment clearly shows light use in the bottoms under rotation grazing.

Utilization during the rest-rotation period of management on the North Pasture Allotment was about half that received during pretreatment period of season-long grazing. The largest reduction in use (10.2 percent) was measured on the meadow types, and the least (3.8 percent) on the grassland types. There was no real change in the pattern of grazing on the different types of vegetation, but rather

Figure 6.--This close utilization of a meadow area in the Lodgepole Allotment is a characteristic of season-long grazing management.

a general decrease over all types. During the 1956-57 period, grazing tended to be concentrated in one part of the allotment and other parts were little used. Under rest-rotation management, the cattle were more equally distributed.

Utilization by Species and Units

On grassland areas in the Lodgepole Allotment, some changes in species utilization are not explainable at present. According to measurements made during the study, utilization of Griffiths wheatgrass increased (table 1), while utilization of slimstem muhly decreased.

On the meadow areas in the Lodgepole Allotment the pattern of species utilization did not change significantly. All species showed reasonably consistent degrees of use from 1957 to 1961. Nebraska sedge and slender wheatgrass carried most of the grazing; Kentucky bluegrass and shortbeak sedge were grazed moderately.

On grassland types in the Green Mountain Allotment, needle-and-thread was by far the most heavily grazed species measured (table 1). This species does reflect the reduced utilization resulting from the rotation system of management on units 1 and 2, but on units 3 and 4 utilization was heavier under rotation grazing. This change is undoubtedly related to changes in the pattern of distribution of the livestock. Average utilization of needle-and-thread under season-long grazing was 20 percent as compared with 14 percent during the rotation period.

Griffiths wheatgrass was more palatable than slimstem muhly on the two units in which it was measured as an indicator of utilization. Utilization of the wheatgrass was lower during the rotation grazing (9.0 percent) than during season-long grazing (13.5 percent).

Slimstem muhly was grazed the least of all species measured. No significant differences in utilization of this species were found between rotation and season-long grazing.

Meadows in units 2 and 3 of the Green Mountain Allotment were more heavily grazed under season-long management than the meadows in units 1 and 4 (table 1). Also, under rotation grazing utilization was more uniformly distributed over all meadows, although those in units 2 and 3 were still grazed more. Based on utilization of Kentucky bluegrass and shortbeak sedge (the only species measured on all units), the average use on units 2 and 3 prior to rotation was 66 percent and during rotation 23.5 percent, or only one-third as heavy. For units 1 and 4, average utilization prior to rotation was 29 percent and during rotation 13 percent, or only half as heavy.

Utilization of the different forage species varied considerably between the Green Mountain and Lodgepole Allotments. Shortbeak sedge was one of the most heavily grazed species on the Green Mountain Allotment, but not on the Lodgepole. Slender wheatgrass was grazed as heavily as Kentucky bluegrass on the Green Mountain allotment, but was more heavily grazed on the Lodgepole Allotment. Tufted hairgrass was very lightly utilized under rotation grazing. Reasons for these inconsistencies in species utilization are not fully understood.

On grassland areas in the North Pasture Allotment, Griffiths wheatgrass was grazed more heavily than slimstem muhly both during and prior to the rest-rotation period (table 1). Under rest-rotation grazing, utilization on Griffiths wheatgrass averaged 5.5 percent as compared with 9.1 percent under season-long grazing; utilization of slimstem muhly averaged 2.9 percent under rest-rotation grazing and 6.8 percent under season-long grazing.

On the mixed-browse type in the North Pasture Allotment, needle-and-thread was the most heavily utilized species under both season-long and rest-rotation grazing. Idaho fescue ranked next under season-long grazing, but sun sedge ranked second under rest-rotation. Utilization of sun sedge and slimstem muhly were about equal at the beginning of the study, but use of the latter decreased considerably under the rest-rotation system whereas the use on sun sedge did not. Griffiths wheatgrass was grazed least in the initial period, but was more palatable than slimstem muhly during the rest-rotation period.

Table 1.--Average utilization by species, units, and grazing systems, during pretreatment period (1956-57) when all units were grazed season-long, and treatment period (1958-61) when Lodgepole Allotment was grazed season-long, Green Mountain by rotation, and North Pasture by rest-rotation

Allotment, unit, vegetative type, and species	Pretreatment 1956-57	Treatment 1958-61
	Pct. weight removed	
LODGEPOLE ALLOTMENT		
Grasslands:		
Griffiths wheatgrass	8.5	14.0
Slimstem muhly	11.5	4.1
Meadows:		
Slender wheatgrass	30.5	36.5
Kentucky bluegrass	27.0	24.6
Nebraska sedge	47.0	45.6
Shortbeak sedge	22.0	25.3
GREEN MOUNTAIN ALLOTMENT		
Grasslands:		
Unit 1 Griffiths wheatgrass	11.0	5.4
Slimstem muhly	1.5	4.9
Needle-and-thread	31.0	14.8
Unit 2 Slimstem muhly	8.8	3.0
Needle-and-thread	25.5	10.6
Unit 3 Griffiths wheatgrass	16.0	12.5
Needle-and-thread	12.0	18.6
Unit 4 Slimstem muhly	1.5	4.4
Needle-and-thread	10.5	12.0
Meadows:		
Unit 1 Slender wheatgrass	28.0	12.1
Kentucky bluegrass	21.0	10.0
Shortbeak sedge	20.5	14.1
Unit 2 Kentucky bluegrass	67.0	16.8
Shortbeak sedge	77.0	20.0
Unit 3 Kentucky bluegrass	58.0	26.6
Shortbeak sedge	60.0	30.4
Unit 4 Slender wheatgrass	33.5	15.0
Kentucky bluegrass	23.0	15.0
Tufted hairgrass	31.5	4.4
Shortbeak sedge	32.5	12.9
NORTH PASTURE ALLOTMENT [1]		
Grasslands:		
Unit 1 Griffiths wheatgrass	9.5	5.0
Slimstem muhly	5.8	3.0
Unit 2 Griffiths wheatgrass	10.5	6.8
Slimstem muhly	7.5	3.8
Unit 3 Griffiths wheatgrass	9.3	6.7
Slimstem muhly	8.8	4.0
Unit 4 Griffiths wheatgrass	7.0	3.7
Slimstem muhly	5.3	.7
Mixed browse:		
Unit 1 Griffiths wheatgrass	7.6	5.8
Slimstem muhly	12.0	3.8
Unit 2 Griffiths wheatgrass	7.0	5.5
Slimstem muhly	10.3	6.0
Idaho fescue	16.0	7.5
Unit 3 Griffiths wheatgrass	8.8	6.2
Slimstem muhly	11.3	3.0
Idaho fescue	9.0	4.5
Sun sedge	12.5	11.2
Unit 4 Griffiths wheatgrass	7.3	5.5
Slimstem muhly	15.0	2.3
Idaho fescue	24.0	3.3
Needle-and-thread	31.5	18.0
Meadows:		
Unit 1 Needle-and-thread	17.4	24.0
Kentucky bluegrass	30.5	15.8
Nebraska sedge	32.9	13.3
Shortbeak sedge	34.0	11.7
Needleleaf sedge	12.0	12.2
Unit 2 Needle-and-thread	33.8	26.3
Kentucky bluegrass	44.0	17.0
Nebraska sedge	29.3	30.2
Shortbeak sedge	22.5	17.8
Needleleaf sedge	9.0	13.2
Unit 3 Slender wheatgrass	33.0	18.8
Needle-and-thread	44.0	25.2
Nebraska sedge	28.3	20.7
Shortbeak sedge	34.3	12.7
Needleleaf sedge	13.0	5.0
Unit 4 Needle-and-thread	39.8	37.3
Nebraska sedge	26.3	16.8
Shortbeak sedge	32.3	10.0
Needleleaf sedge	15.8	10.7

[1] Rest-rotation grazing: average of years of actual use only.

Table 2. --Average utilization by species and period of use during treatment period, 1958-61, on Green Mountain Allotment (rotation grazing) and North Pasture (rest-rotation grazing)

Allotment and vegetative type	Species	First period	Second period	Third period	Fourth period
		- - - Percent weight removed - - -			
GREEN MOUNTAIN ALLOTMENT:					
Grasslands	Griffiths wheatgrass	7.0	8.5	8.5	12.0
	Slimstem muhly	3.3	7.3	3.8	1.8
	Needle-and-thread	11.3	17.0	18.6	9.1
	Average	7.2	10.9	10.3	7.6
Meadows	Slender wheatgrass	13.0	5.5	13.0	22.8
	Kentucky bluegrass	17.8	23.1	15.3	12.5
	Tufted hairgrass[1]	7.5	1.5	6.5	2.2
	Shortbeak sedge	21.5	20.5	20.0	15.4
	Average	14.9	12.6	13.7	13.2
NORTH PASTURE ALLOTMENT:					
Grasslands	Griffiths wheatgrass	3.8	6.4	6.5	([2])
	Slimstem muhly	2.5	3.4	2.6	([2])
	Average	3.2	4.9	4.6	([2])
Mixed browse	Griffiths wheatgrass	4.1	6.1	7.0	([2])
	Slimstem muhly	2.6	4.9	3.9	([2])
	Idaho fescue	2.5	3.1	5.9	([2])
	Needle-and-thread	36.0	17.0	1.0	([2])
	Sun sedge[1]	5.0	9.0	19.5	([2])
	Average	10.0	8.0	7.5	([2])
Meadows	Slender wheatgrass[1]	7.5	27.0	22.0	([2])
	Kentucky bluegrass	6.8	15.0	27.5	([2])
	Needle-and-thread	26.0	22.6	36.0	([2])
	Needleleaf sedge	8.3	8.8	13.8	([2])
	Shortbeak sedge	12.4	13.0	13.8	([2])
	Nebraska sedge	13.8	21.4	25.6	([2])
	Average	12.5	18.0	23.1	([2])

[1] Occurred on one unit only.
[2] Rest period; no grazing.

With season-long use on the meadows of the North Pasture Allotment, relative utilization of the species studied varied considerably. For example, needle-and-thread was very lightly utilized in unit 1 (17.4 percent) but was the most heavily grazed species in unit 3 (44 percent, table 1). Utilization on all species except needleleaf sedge averaged between 29.2 percent (Nebraska sedge) and 37.2 percent (Kentucky bluegrass), however, which indicates that for the whole allotment there was little difference among the species. Needleleaf sedge was only grazed an average of 12.4 percent.

During the rest-rotation period of grazing, variation in utilization for the different species was shown more clearly. Based on average utilization the ratings were as follows:

	Percent
Season-long:	
Kentucky bluegrass	37.2
Needle-and-thread	33.8
Slender wheatgrass	33.0
Shortbeak sedge	30.8
Nebraska sedge	29.2
Needleleaf sedge	12.4
Rest-rotation:	
Needle-and-thread	28.2
Nebraska sedge	20.2
Slender wheatgrass	18.8
Kentucky bluegrass	16.4
Shortbeak sedge	13.0
Needleleaf sedge	10.3

Utilization by Period of Use

The time of year that an area was grazed had little effect on the intensity of utilization on grassland types. This was true on both the Green Mountain and North Pasture Allotments (table 2). There was some indication that the cattle grazed the upland areas more heavily in midsummer than either earlier or later in the year, but the differences are not significant. Greater freedom from flies because of the almost constant winds on the upland areas may have been responsible for the slight preference cattle exhibited for these areas during midsummer.

On the more heavily stocked Green Mountain Allotment there was no significant difference in the average utilization of the meadow types as related to time of grazing. On the lightly stocked North Pasture, however, utilization was lightest during the early part of the season. Utilization was heaviest during the last period of grazing, September 1 to October 15, probably because the meadow vegetation stayed green late into the season.

The mixed-browse type in the North Pasture Allotment was grazed most heavily during the first period, June 1 to July 16. These areas provide good shelter during the cold storms and winds that occur frequently during this period.

The utilization of individual species in relation to time of grazing was highly variable and, in certain instances, inconsistent. Whenever Griffiths wheatgrass was used as an indicator of utilization, however, it was used most heavily during the last period of grazing. Needle-and-thread was grazed most heavily in the mixed-browse type during the early summer, in the grassland types in midsummer, and in meadow types in late summer. Use on slender wheatgrass, Kentucky bluegrass, and tufted hairgrass was also inconsistent. In general, the sedges were grazed most heavily late in the season.

From these studies it would appear that grazing use of different vegetation types and of individual species of plants is related more to the needs and preference of the animal than to the time of year the range is grazed.

Changes in Plant Cover

Plant cover did change during the period of study. Transect measurements, by number of hits per 100-foot transect, in 1958 and again in 1962 showed the following changes in vegetative cover by three methods of range management:

	Original 1958	Change 1962
Lodgepole (season-long grazing, both periods):		
Wet bottoms	78	+ 5
Grasslands	43	+ 4
Green Mountain (rotation grazing):		
Wet bottoms	77	+10
Grasslands	60	- 1
North Pasture (rest-rotation grazing):		
Wet bottoms	76	+15
Dry bottoms	61	+20
Grassland	46	+12
Mixed shrub	29	+13

In the wet-meadow type in the Lodgepole Allotment, the number of loops that contained living plants increased 6 percent. The same type on the Green Mountain Allotment showed an increase of 13 percent.

In the wet-meadow types on the North Pasture Allotment, the number of loops contain-

ing vegetation increased 20 percent (fig. 7). The increase was even greater (33 percent) on the dry-meadow types in this allotment.

The upland types in the Lodgepole and Green Mountain Allotments showed no significant change in the number of loops containing vegetation. On the North Pasture Allotment, however, the number of loops containing vegetation increased 26 percent (fig. 8).

Mixed-browse types in the North Pasture Allotment also improved--the number of loops containing vegetation increased 45 percent.

These gross changes in the vegetative cover were comprised of small changes in many species. In the meadow type on the Lodgepole Allotment, the largest species change was an average increase of 17.3 hits per transect (table 3) for Kentucky bluegrass. Tufted hairgrass and rose pussytoes increased 4.0 and 4.5 hits per transect, respectively. Some species decreased in abundance. The largest decreases were recorded for prairie Junegrass, mat muhly, sedges (other than Nebraska sedge), and decumbent goldenrod.

On the Green Mountain Allotment, the only change measured of any real magnitude was an increase of 5.1 hits per transect on Kentucky bluegrass. This was also true on the meadows in the North Pasture Allotment, where Kentucky bluegrass increased 5.7 hits per transect. Some other species did show increases, but of smaller magnitude--slender wheatgrass, prairie Junegrass, alpine timothy, and needle-and-thread all increased within a range from 1.2 to 2.6 hits per transect. There were no significant decreases in any of the species on either Green Mountain or the North Pasture Allotments. The largest decrease was 1.7 hits on Baltic rush in the Green Mountain Allotment.

In the grassland type, large decreases in number of hits per transect were noted on the Lodgepole Allotment for both three-tip sagebrush and selaginella (table 3). Slimstem muhly also decreased, but not as much. Small but important increases were noted for prairie Junegrass. No significant changes occurred in species hits on the Green Mountain Allotment. On the North Pasture Allotment the changes in species hits also were small. The greatest changes took place in three-tip sagebrush (+2.1), prairie Junegrass (+1.9), slimstem muhly (+1.5), and rose pussytoes (+1.5). It is important, however, that almost all species did increase in number of hits per transect, and on these poor soils and dry sites such changes could be interpreted as an improvement in the vegetative cover.

In the mixed-browse type on the North Pasture Allotment, no species decreased in number of hits per transect. Average increase in the number of hits per 100 observations between 1958 and 1962 by species was:

Griffiths wheatgrass	1.3
Parry danthonia	.1
Idaho fescue	1.3
Spikefescue	.1
Prairie Junegrass	.9
Slimstem muhly	1.1
Mountain muhly	.2
Sandberg bluegrass	2.4
Needle-and-thread	.1
Sedges	.4
Rose pussytoes	.4
Sandwort	.1
Subalpine eriogonum	.4
Big sagebrush	.6
Bitterbrush	2.3

Griffiths wheatgrass, Idaho fescue, Sandberg bluegrass, and antelope bitterbrush all increased appreciably. Other species changes were small.

Discussion

Results of this study indicate that either rotation or rest-rotation systems of management can benefit cattle ranges. The most striking result is reduced utilization without any reduction in the number of animals grazed. The rotation system on the Green Mountain Allotment resulted in much greater decreases in utilization on the meadow types than the rest-rotation system on the North Pasture Allotment. This does not necessarily mean that the rotation system is better than the rest-rotation system. Both stocking rates and utilization were lighter on the North Pasture Allotment to begin with, so the opportunity for reductions were not so great. Hormay

NORTH PASTURE ALLOTMENT

(Rest-rotation management)

MEADOW TYPE

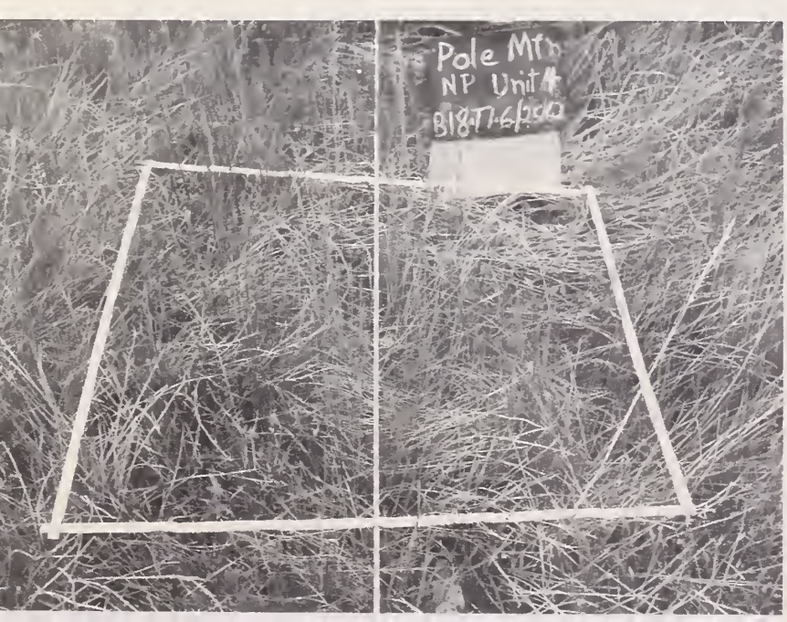
GRASSLAND TYPE

BEFORE TREATMENT (1958)

Figure 7.--Grasses have increased and forbs decreased on this same spot in Unit 4. Vegetation increased 20 percent in wet meadows and 33 percent in dry meadows.

Figure 8.--Vegetation increased 26 percent on this same spot in Unit 3. Grasses are more numerous and more vigorous.

AFTER TREATMENT (1962)



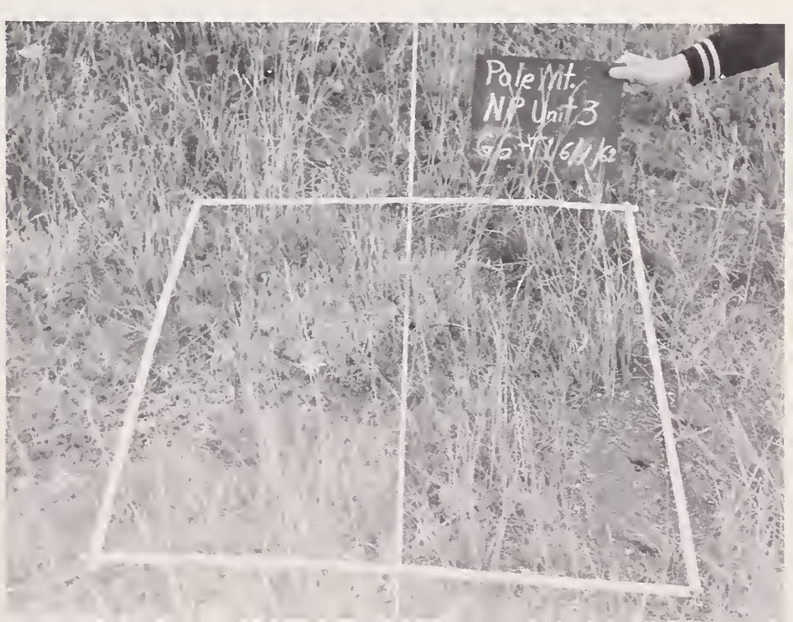


Table 3.--Change in frequency of species occurrence, by vegetative type, as a result of three methods of grazing management on three allotments of the Pole Mountain unit, Medicine Bow National Forest, Wyoming, 1958-62

Vegetative type	Species	Lodgepole Allotment (Season-long)	Green Mountain Allotment (Rotation)	North Pasture Allotment (Rest-rotation)
		Average change in number of hits per 100 observations		
Grasslands	Griffiths wheatgrass	+1.2	-0.1	+0.7
	Blue grama	-1.5	+ .9	- .1
	Parry danthonia	--	- .1	+ .01
	Idaho fescue	--	- .04	+ .2
	Prairie Junegrass	+2.9	- .1	+1.9
	Slimstem muhly	-2.7	-1.0	+1.5
	Sandberg bluegrass	+1.1	+ .7	+1.3
	Needle-and-thread	+ .4	- .4	- .1
	Sedges	+ .7	+ .5	+ .1
	Rose pussytoes	+ .2	+ .5	+1.5
	Sandwort	+ .9	+ .04	+ .4
	Phlox	+ .2	--	+ .3
	Loco	--	--	- .05
	Selaginella	-3.6	-1.0	+ .9
	Fringed sagebrush	- .4	-1.2	+ .5
	Three-tip sagebrush	-8.7	+ .1	+2.1
Meadows	Slender wheatgrass	-2.5	+0.2	+2.6
	Tufted hairgrass	+4.0	- .8	- .2
	Prairie Junegrass	-3.2	+1.2	+1.7
	Mat muhly	-3.9	-1.8	- .5
	Alpine timothy	+ .5	+1.1	+1.2
	Kentucky bluegrass	+17.3	+5.1	+5.7
	Sandberg bluegrass	-1.7	+ .3	+1.1
	Needle-and-thread	+ .3	+ .8	+2.3
	Nebraska sedge	+ .3	- .3	+ .3
	Sedges	-3.6	-2.6	- .9
	Rush	- .2	-1.7	+1.0
	Yarrow	+ .8	- .3	- .3
	Rose pussytoes	+4.5	+ .9	- .9
	Decumbent goldenrod	-4.5	+ .1	+ .2
	Dandelion	- .3	+ .3	+1.0
	Fringed sagebrush	+ .4	- .6	- .2

and Talbot[6] believe, "Fairly heavy stocking is desirable in rest-rotation grazing"; this is certainly true if maximum benefits are to be obtained from the system. On the North Pasture Allotment, the stocking rate was estimated to be about 50 percent of capacity at the start of the study. Green Mountain, on the other hand, was estimated to need a 50 percent reduction in numbers under season-long use to achieve proper use of the bottoms.

Reasons for reduced utilization without reduction in livestock numbers have not been fully determined. Several factors may be involved: (1) increased total production of herbage because of increased plant vigor; (2) growth and production of herbage are allowed

[6] *Hormay, A. L. and Talbot, M. W. Rest-rotation grazing...A new management system for perennial bunchgrass ranges. U. S. Dept. Agr. Prod. Res. Rpt. 51, 43 pp., illus. 1961.*

to get "ahead of the cattle" each year on all but one unit in either system of management, and (3) the previous year's regrowth after grazing is mixed with the current year's growth, which provides more bulk in the diet. Other factors not yet recognized may also be important.

Another important result was the more uniform distribution of grazing use over the entire allotment. Again, the rotation system on Green Mountain illustrates this improved uniformity most clearly because of the heavier utilization involved. Under season-long grazing, the meadows in two of the units were carrying most of the grazing load. The rotation system spread this load more uniformly over all the units. Similarly, needle-and-thread in the grassland type was being most heavily grazed on two units under season-long use. Under the rotation system, use on this grass decreased on these units but increased on the two units where it had previously been very light. Similar trends toward more uniform use over the whole allotment were present but in much lesser magnitude on the North Pasture Allotment under the rest-rotation system of management.

Total plant cover definitely changed during the 4 years of the rotation period. The changes were of greatest magnitude under the rest-rotation system for all types for which comparisons were available. The increase in cover on meadow types amounted to 20 percent, 13 percent, and 6 percent for the rest-rotation under light stocking, rotation under heavy stocking, and season-long under moderate stocking, respectively. Corresponding increases on the grassland type were 26 percent, -2 percent (decrease), and 9 percent in the same order. For this area, which has relatively low-fertility granitic soils with poor water-holding capacity, and semiarid and windy climate, changes of this magnitude during a 4-year period are somewhat surprising.

The changes in frequency of individual species were small, and except for Kentucky bluegrass were probably insignificant except for the consistency with which they indicate a trend. These changes were most pronounced in the meadow types.

Although Kentucky bluegrass is a good forage species, and in many instances may be more desirable than some native species, it is definitely an invader and known to increase under heavy grazing. This plant increased on all allotments, but the increase on the one used season-long was more than three times as much as on either of the other two allotments. Some of this increase occurred at the expense of good native forage species (fig. 9).

Three poor forage species--rose pussytoes, fringed sagebrush, and yarrow--commonly accepted indicators of range deterioration, increased on the allotment grazed season-long but decreased (or made very slight increase) on the rest-rotation and rotation allotments.

A group of good forage species--slender wheatgrass, Sandberg bluegrass, prairie Junegrass, and decumbent goldenrod--all decreased on the season-long allotment but increased under the other two systems of management.

A group of sedges, all of which are good forage species, decreased on all three allotments. The greatest decrease, however, occurred on the season-long allotment and the least on the rest-rotation allotment.

When one rationalizes these changes in cover, it appears obvious that a system of rest-rotation management will stimulate range improvement more rapidly than a simple rotation system, but either method will be more beneficial to the range than the customary practice of grazing season-long.

Rotation or rest-rotation systems of management cannot be initiated without encountering some difficulties. The most frequent problem is concentration of use along fence lines. Whenever livestock, especially cows with calves, are forced to give up their established and preferred grazing areas on an allotment they will "fight the fences" trying to get to those preferred areas. This results in excessive trampling and use along the fence lines. Fortunately, this situation exists only during the first year; by the second year the animals have adjusted to their new grazing areas and

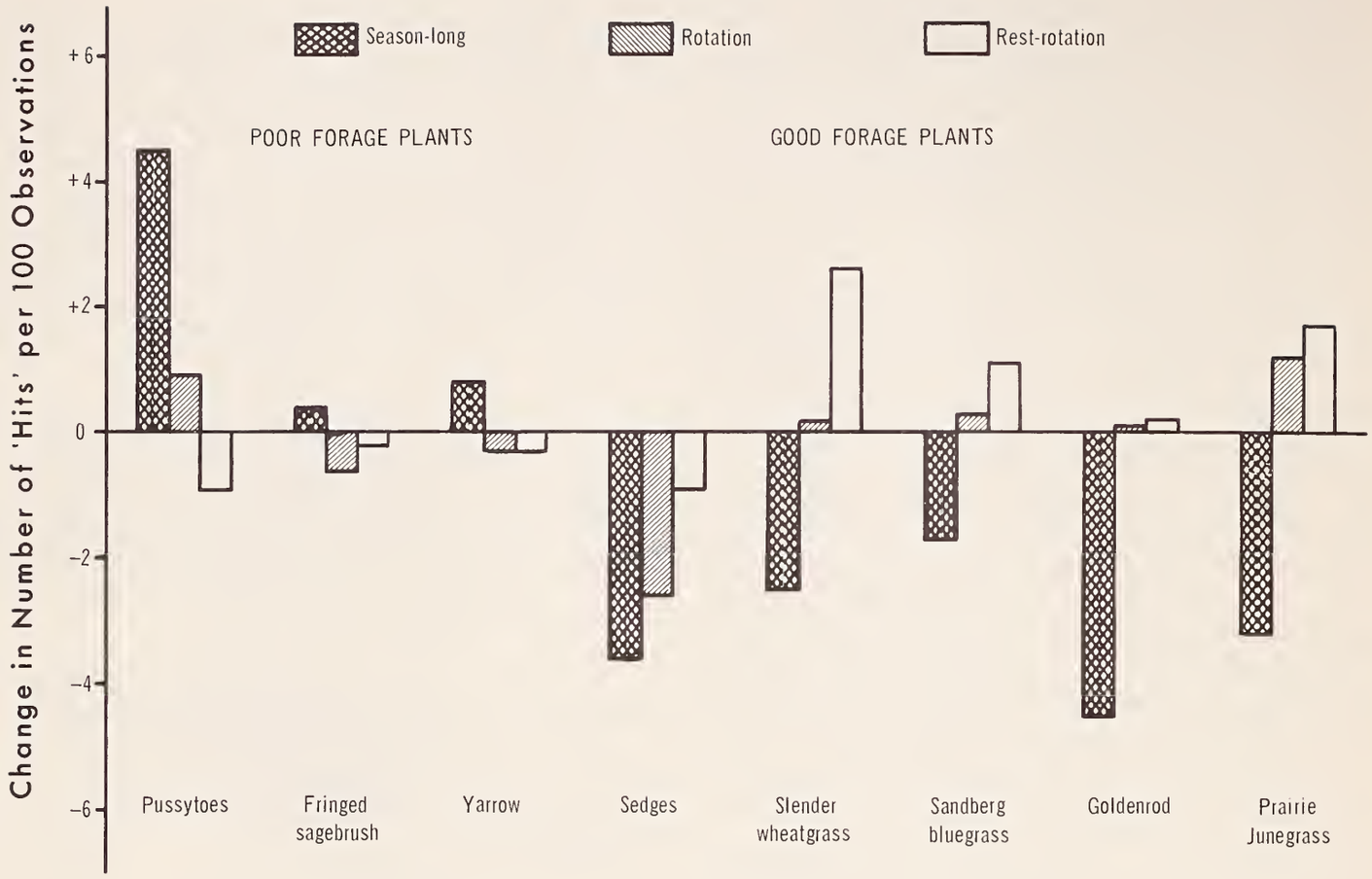


Figure 9.--Changes in the occurrence of selected native species in relation to type of grazing management, meadow types, Pole Mountain 1958-62.

the problem is eliminated. This situation actually developed on the North Pasture Allotment during the first year of rotation.

Another common problem is the failure to equalize grazing capacities in units within the allotments. This is not serious unless the differences are great. An adjustment in the number of days of grazing will generally correct this situation. As Hormay and Talbot[6] have stated, however, "In effect, grazing is eliminated as an environmental factor under rest-rotation grazing." This means that the range manager using an adequately planned system of rest-rotation grazing need not be as concerned about heavy rates of utilization.

Rotation and rest-rotation systems of management have sufficient flexibility to meet most range conditions. Properly planned and executed they can be beneficial. They must, however, be planned so that the physiological needs of the vegetation are most effectively met.

COMMON AND BOTANICAL NAMES OF SPECIES MENTIONED

Bitterbrush, antelope	*Purshia tridentata* (Pursh) DC.
Bluegrass, Kentucky	*Poa pratensis* L.
Bluegrass, Sandberg	*Poa secunda* Presl.
Dandelion	*Taraxacum* spp.
Danthonia, Parry	*Danthonia parryi* Scribn.
Eriogonum, subalpine	*Eriogonum subalpinum* Greene
Fescue, Idaho	*Festuca idahoensis* Elmer
Goldenrod, decumbent	*Solidago decumbens* Greene
Grama, blue	*Bouteloua gracilis* (H.B.K.) Lag.
Hairgrass, tufted	*Deschampsia caespitosa* (L.) Beauv.
Junegrass, prairie	*Koelaria cristata* (L.) Pers.
Loco	*Astragalus* spp.
Muhly, mat	*Muhlenbergia richardsonis* (Trin.) Rydb.
Muhly, mountain	*Muhlenbergia montana* (Nutt.) Hitchc.
Muhly, slimstem	*Muhlenbergia filiculmis* Vasey
Needle-and-thread	*Stipa comata* Trin. & Rup.
Phlox	*Phlox* spp.
Pine, ponderosa	*Pinus ponderosa* Lawson
Pussytoes, rose	*Antennaria rosea* (D. C. Eaton) Greene
Reedgrass, bluejoint	*Calamagrostis canadensis* (Michx.) Beauv.
Rush, Baltic	*Juncus balticus* Willd.
Sagebrush, big	*Artemisia tridentata* Nutt.
Sagebrush, fringed	*Artemisia frigida* Willd.
Sagebrush, three-tip	*Artemisia tripartita* Rydb.

Sandwort	*Arenaria* spp.
Sedge, Nebraska	*Carex nebraskensis* Dewey
Sedge, needleleaf	*Carex eleocharis* Bailey
Sedge, shortbeak	*Carex simulata* Mack.
Sedge, sun	*Carex heliophila* Mack.
Selaginella	*Selaginella densa* Rydb.
Spikefescue	*Hesperochloa kingii* (S. Wats.) Rydb.
Timothy, alpine	*Phleum alpinum* L.
Wheatgrass, Griffiths	*Agropyron griffithsii* (Scribn. & Smith)
Wheatgrass, slender	*Agropyron trachycaulum* (Link) Malte
Wheatgrass, western	*Agropyron smithii* Rydb.
Yarrow	*Achillea lanulosa* Nutt.

Johnson, W. M.
1965. Rotation, rest-rotation, and season-long grazing on a mountain range in Wyoming. U. S. Forest Serv. Res. Paper RM-14, 16 pp., illus. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Either rotation or rest-rotation systems of management were superior to season-long grazing. Plant cover increased under rest-rotation grazing, and was maintained on an overstocked allotment under rotation grazing. Range deteriorated under season-long grazing. Herbage utilization was reduced under both the rest-rotation and rotation systems without reducing numbers of livestock.

Johnson, W. M.
1965. Rotation, rest-rotation, and season-long grazing on a mountain range in Wyoming. U. S. Forest Serv. Res. Paper RM-14, 16 pp., illus. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Either rotation or rest-rotation systems of management were superior to season-long grazing. Plant cover increased under rest-rotation grazing, and was maintained on an overstocked allotment under rotation grazing. Range deteriorated under season-long grazing. Herbage utilization was reduced under both the rest-rotation and rotation systems without reducing numbers of livestock.

Johnson, W. M.
1965. Rotation, rest-rotation, and season-long grazing on a mountain range in Wyoming. U. S. Forest Serv. Res. Paper RM-14, 16 pp., illus. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Either rotation or rest-rotation systems of management were superior to season-long grazing. Plant cover increased under rest-rotation grazing, and was maintained on an overstocked allotment under rotation grazing. Range deteriorated under season-long grazing. Herbage utilization was reduced under both the rest-rotation and rotation systems without reducing numbers of livestock.

Johnson, W. M.
1965. Rotation, rest-rotation, and season-long grazing on a mountain range in Wyoming. U. S. Forest Serv. Res. Paper RM-14, 16 pp., illus. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Either rotation or rest-rotation systems of management were superior to season-long grazing. Plant cover increased under rest-rotation grazing, and was maintained on an overstocked allotment under rotation grazing. Range deteriorated under season-long grazing. Herbage utilization was reduced under both the rest-rotation and rotation systems without reducing numbers of livestock.